

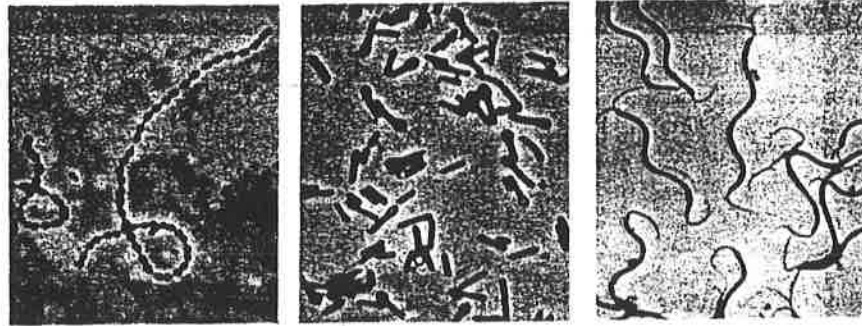
CHARACTERISTICS OF ORGANISMS IN THE KINGDOM EUBACTERIA

1. Cells are prokaryotic, and thus lack a nucleus, mitochondria, plastids, and dictyosomes. Some internal membranes are present.
2. Cells are tiny, typically only 1 μm long.
3. DNA in a single circular chromosome, not associated with histones.
4. New cells are produced by fission, after the chromosome replicates; mitosis does not occur.
5. No sexual reproduction via meiosis, gamete formation, or syngamy; instead bits of chromosomes are exchanged between cells.
6. Cells are bound by a wall composed of peptidoglycans. An outer lipopolysaccharide layer may also be present (Gram-negative bacteria).
7. Have a variety of shapes, often classified as coccus, bacillus, spirillum, and vibrio. May be unicellular, filamentous or colonial.

8. Diverse feeding strategies; include heterotrophic, photoautotrophic and chemoautotrophic metabolism.
9. Diverse oxygen requirements; include aerobic, facultative anaerobes, obligate anaerobes, and microaerobe types.
10. Some bacteria fix nitrogen.
11. Exceedingly important in ecosystems. Function as producers, saprobes, parasites and pathogens. May be free-living or mutualistic.
12. Taxonomic types include gram positive and gram negative bacteria, cyanobacteria, actinomycetes, mycoplasmas.
13. Among the oldest of all organisms, fossil monerans dating to 3.5 billion years old have been found.

Representatives of the Kingdom Eubacteria

Bacterial Cells and Colonies



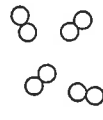
A Cocci in chains

B Bacilli

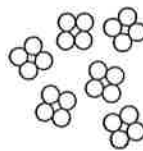
C Spirilla



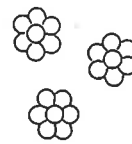
streptococcus



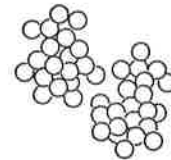
diplococcus



tetrads



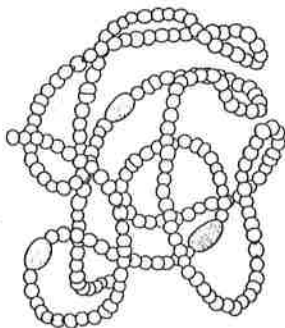
sarcina



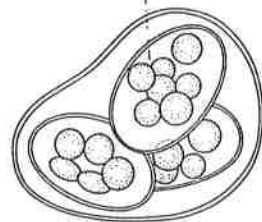
staphylococcus

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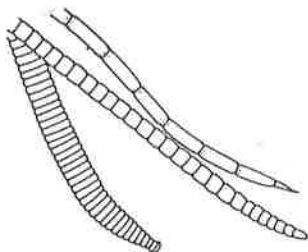
Cyanobacteria (blue-green algae)



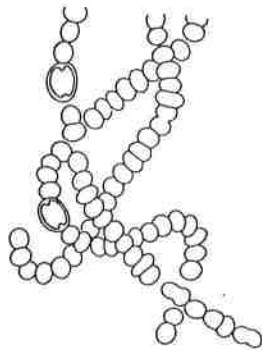
Anabaena circinalis



Anacystis montana

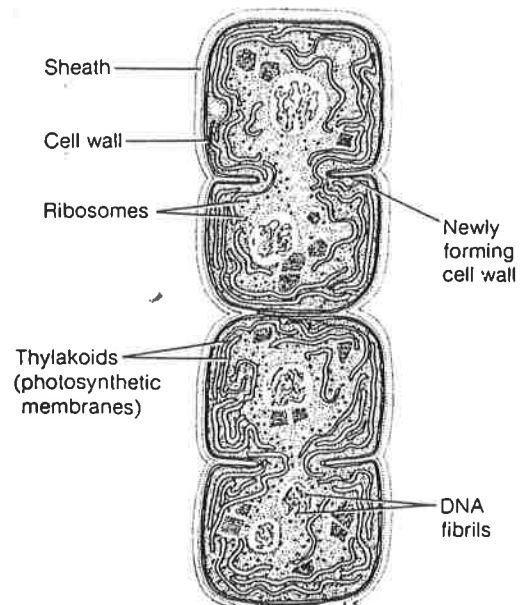


Oscillatoria splendida (top)
Oscillatoria chalybea (middle)
Oscillatoria princeps (bottom)



Nostoc pruniforme

Ultrastructure of *Anabaena*



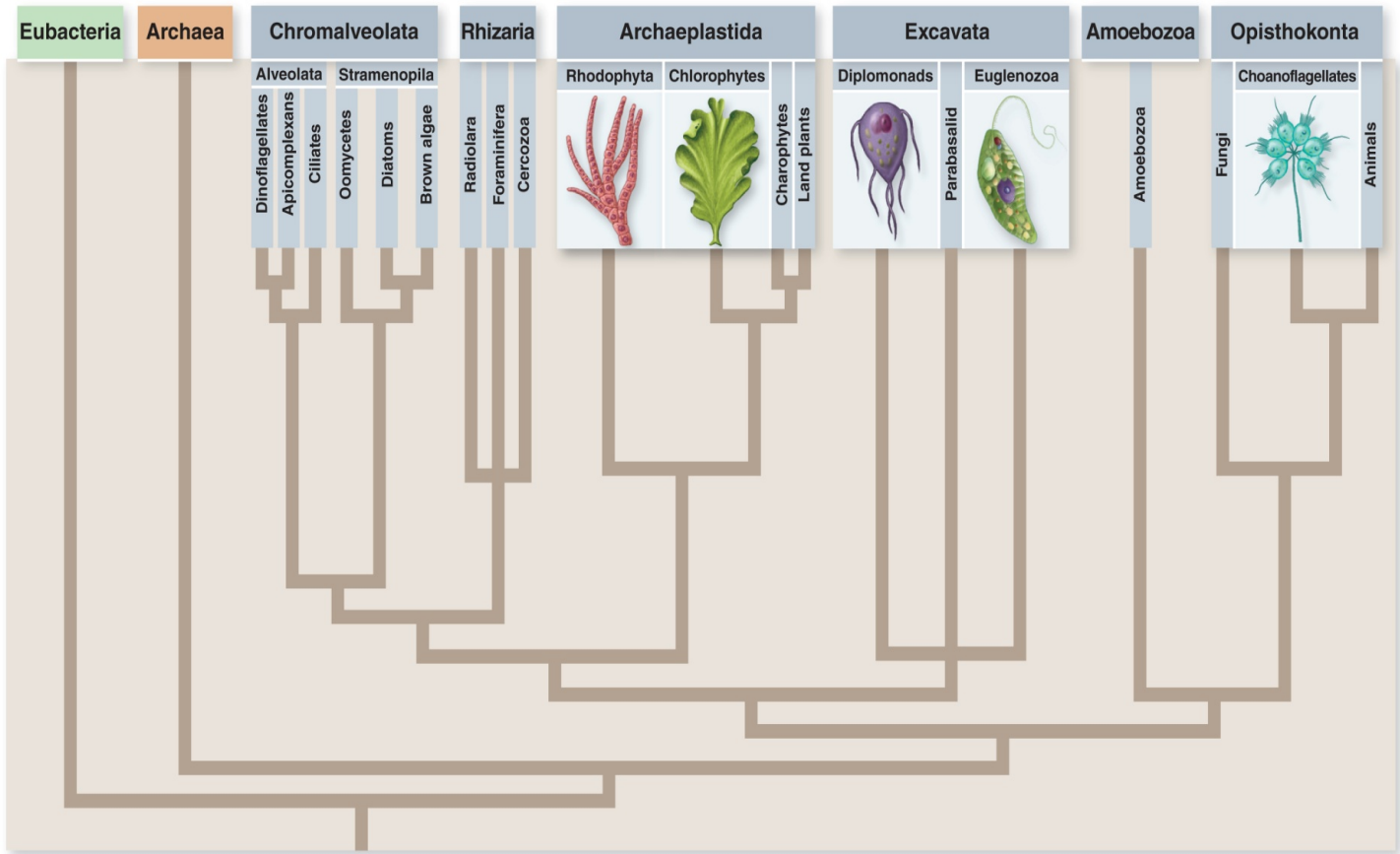
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CHARACTERISTICS OF EUKARYOTIC ORGANISMS

1. Cells contain a nucleus, mitochondria, plastids, and golgi bodies.
2. Evolved as a result of endosymbiosis
3. Cells are larger than Eubacteria and Archaeobacteria, typically at least $5\text{ }\mu\text{m}$ long.
4. DNA typically in several chromosomes, associated with histones.
5. New cells are produced by mitosis.
6. Sexual reproduction via meiosis, gamete formation, and syngamy is found in many groups. Life cycles are sometimes complex.
7. Cells are bound by plasmalemma composed of phospholipids and proteins, with cholesterol present. Many groups have walls composed of various polysaccharides or proteins.
8. Flagella, when present, have a 9+2 arrangement of microtubules composed of tubulin.
9. Some groups are heterotrophic, others photosynthetic.
10. Bodies include unicellular, colonial, filamentous, coenocytic and multicellular forms.

Classification of the Eukaryotes

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Synopsis of the Supergroups

Excavata – Unicellular with feeding groove and often highly modified mitochondria
(*Euglena*, *Giardia*, *Trichomonas*, *Trypanosomes*)

Rhizaria – Unicells with long, thin pseudopodia (radiolarians, foraminifera)

Chromalveolata – Unicellular or multicellular with alveoli beneath cell membrane or heterokont flagella (dinoflagellates, *Plasmodium*, ciliates, water molds, diatoms, brown algae)

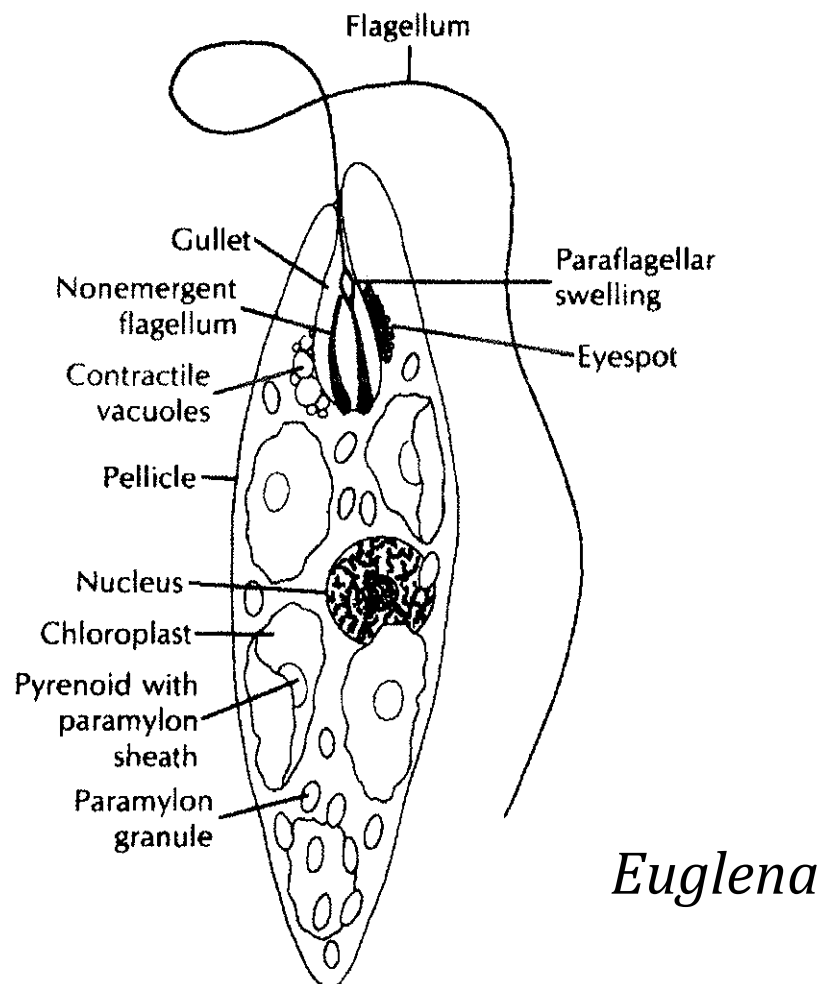
Archaeplastida – Photosynthetic, often complex organisms (Red algae, Green algae, Plants)

Amoebozoa – Heterotrophs with blunt pseudopodia (*Amoeba*, plasmodial slime molds, cellular slime molds)

Opisthokonta – Heterotrophs with single posterior flagellum (Fungi, Animals)

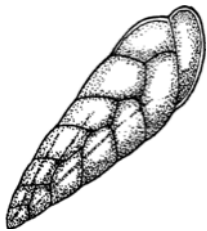
EXCAVATA: EUGLENOZOA (EUGLENIDS)

1. All unicellular.
2. Cell wall composed of protein strips (pellicle).
3. Each cell with two apical flagella (one long and the other short).
4. Mostly heterotrophic and free-living, about 1/3 of genera autotrophic.
5. Photosensitive paraflagellar swelling and eyespot (stigma) found at anterior end.
6. Typically found quiet, shallow freshwater habitats.



RHIZARIA – FORAMINIFERA (FORAMINIFERANS)

1. Bodies are variously shaped, but are covered by a porous shell called a test, composed of inorganic material (calcium carbonate, silicon dioxide).
2. Threadlike podia emerge from the tests, and are used for swimming and feeding.
3. Name from foramen, opening between chambers in the test.
4. Occur in oceans, either in open water, in sand, or attached to other organisms.
5. Important economically, used as indicator species for oil exploration and as chalk.
6. Life-cycle complex, involving sexual reproduction.



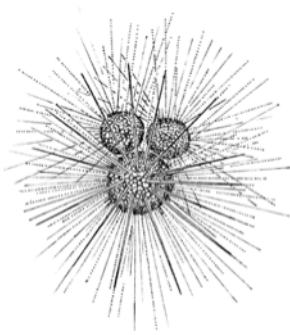
Loxostomum



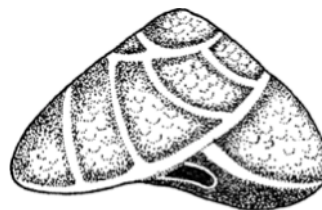
Cornuspira



Bulimina



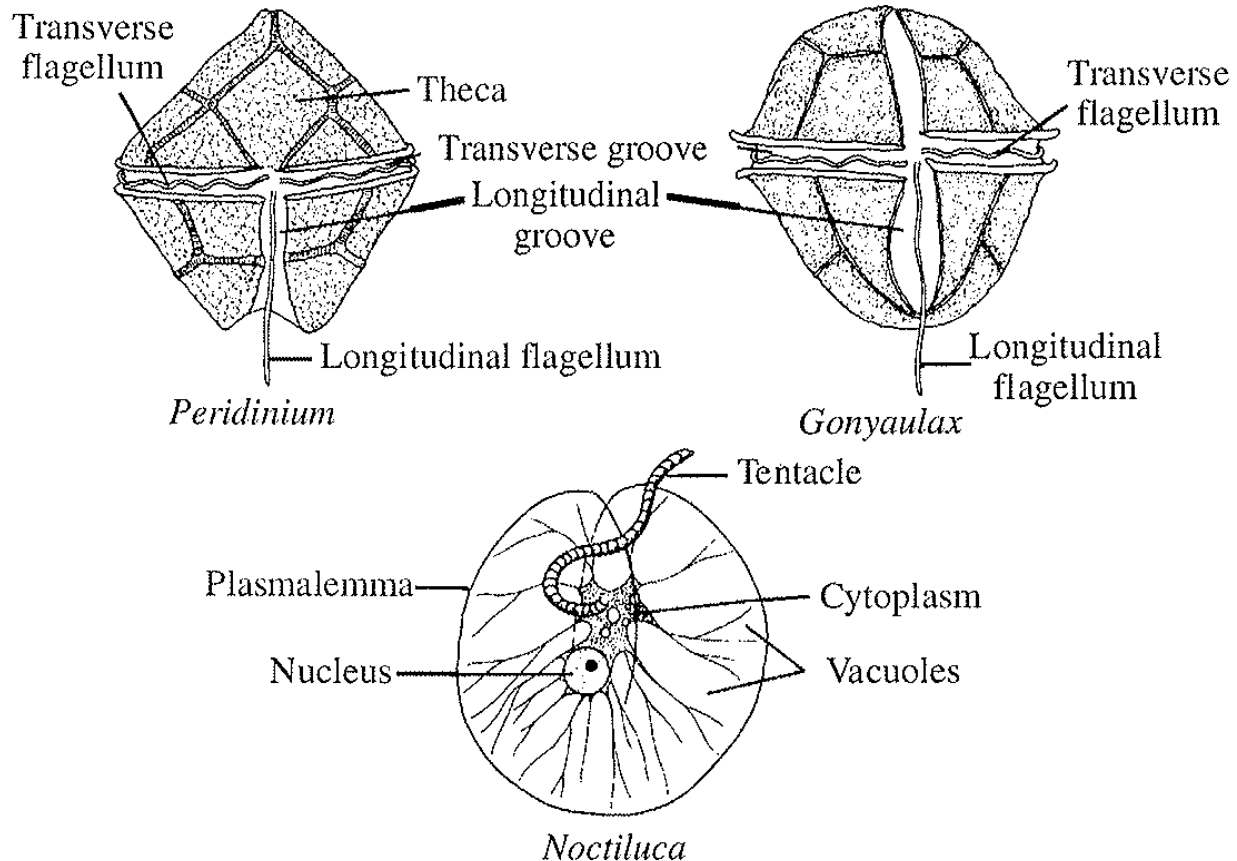
Globigerina



Asterigerina

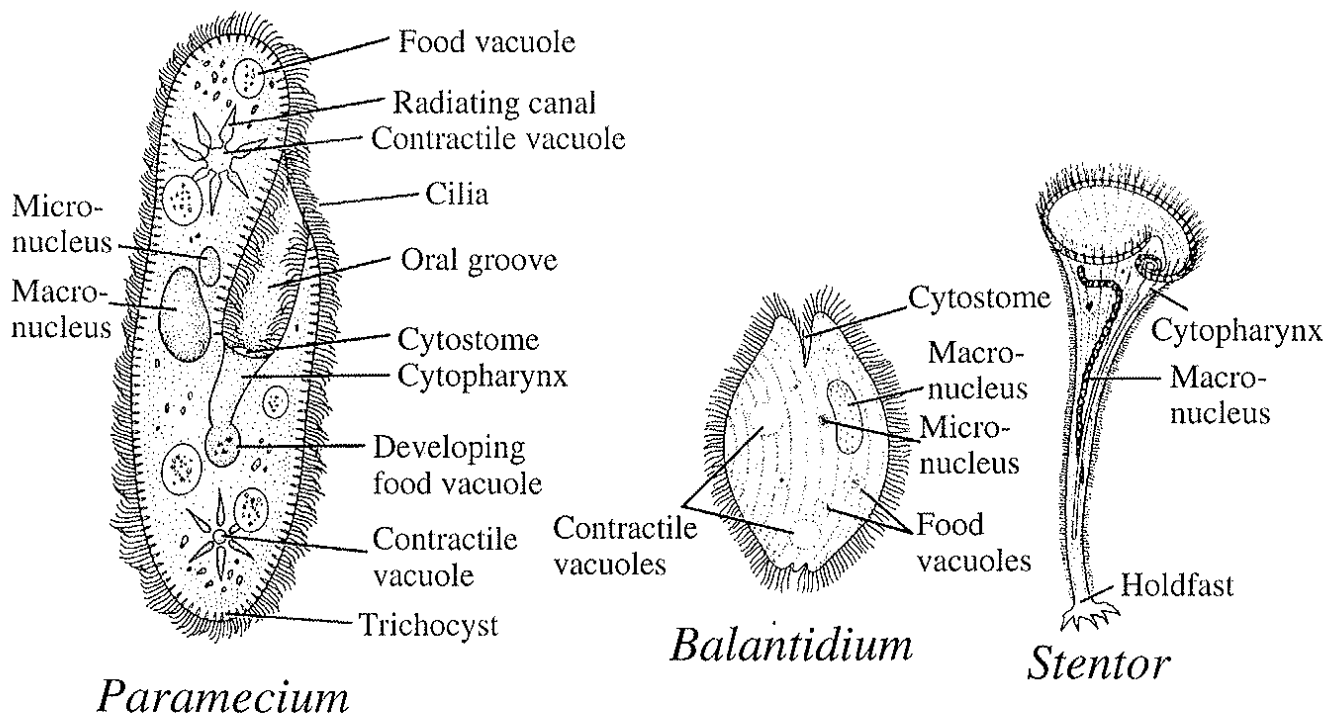
ALVEOLATA - DINOFLAGELLATA (DINOFLAGELLATES)

1. Mostly unicellular.
2. Cell wall composed of cellulose plates (theca).
3. Each cell with two perpendicular flagella.
4. Mostly autotrophic and free-living. Some associated with marine invertebrates (zooxanthellae).
5. Typically found in oceans.
6. Some members toxic and bioluminescent.



ALVEOLATA - CILIATES

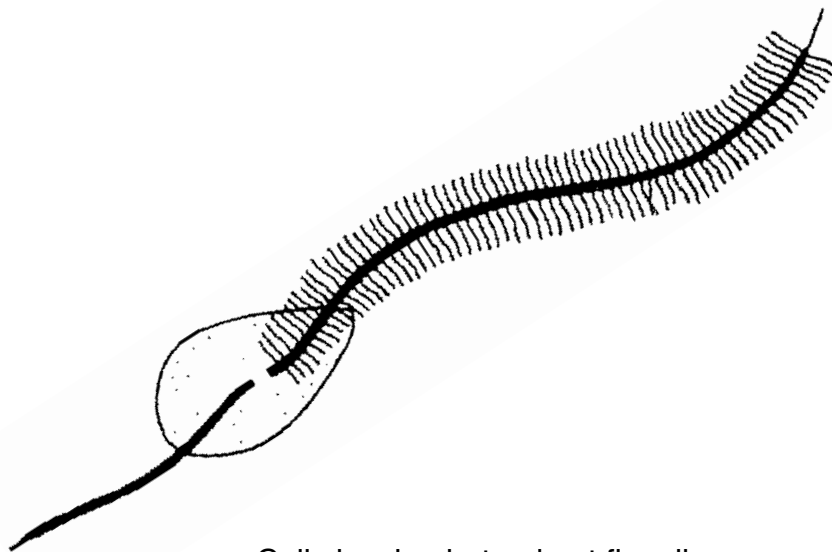
1. Bodies are slipper-shaped, covered with a flexible outer wall (the pellicle), and numerous cilia.
2. Some species have trichocysts, organelles that discharge filaments for trapping prey.
3. Have a macronucleus and micronuclei.
4. Reproduce sexually by conjugation and asexually by transverse fission.
5. Food enters a gullet and passes into a food vacuole. Wastes are removed via a cytoproct.
6. Excess water is removed via contractile vacuoles.
7. Most are free-living in fresh water. A few are sedentary (*Stentor*).



Diagrams from Abramoff and Thompson (1986)

STRAMENOPILA (CHROMISTS)

1. Representatives include unicellular, filamentous, colonial, coenocytic, or multicellular forms. Some can be enormous (to 100m long)
2. Cell wall composed of cellulose, often with alginic acid and sulfated mucopolysaccharides. Many incorporate silicon dioxide or calcium carbonate into their walls.
3. Nutrition is mostly photosynthetic, though some are heterotrophic by absorption.
4. Photosynthetic pigments are chlorophyll, carotenes, and a brown pigment fucoxanthin.
5. Nearly all produce cells with heterokont flagella.
6. Mostly found in open water or damp soil.

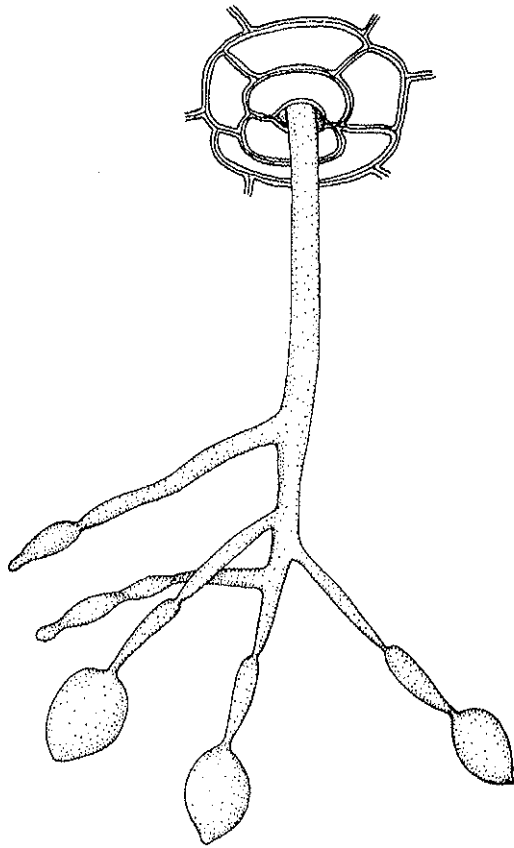


Cell showing heterokont flagella

Diagram from Scagel et al. (1982)

STRAMENOPILA – OOMYCOTA (WATER MOLDS)

1. Nutrition is by absorption; either saprobic or parasitic
2. Body is coenocytic filament.
3. Cell wall composed of glucans (not chitin).
4. Gametes and zoospores with two flagella.
5. Usually found in moist habitats.
6. Economically important: cabbage rot, downy mildew of grapes, late blight of potatoes.

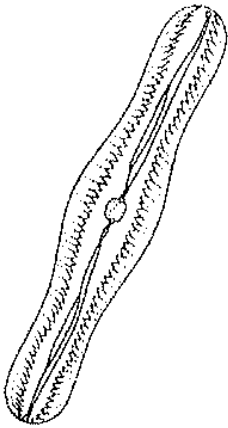


Phytophthora infestans, which causes the late blight of potato, a representative member of the Oomycota. A sporangiophore and sporangia are evident in this diagram.

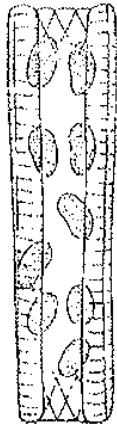
Diagram from Scagel et al. (1982)

STRAMENOPILA - BACILLARIOPHYTA (DIATOMS)

1. Mostly unicellular, sometimes colonial; cells are centric or pennate.
2. Cell wall composed of cellulose, often with silicates, forming a frustule.
3. Flagella limited to gametes in a few groups.
4. Autotrophic by photosynthesis; photosynthetic pigments are chlorophyll, carotenes, xanthophylls (including fucoxanthin).
5. Typically found in oceans and freshwater.
6. Mostly autotrophic and free-living.
7. Economically important as diatomaceous earth.



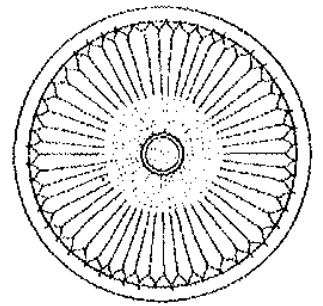
Pinnularia



Diatoma



Navicula

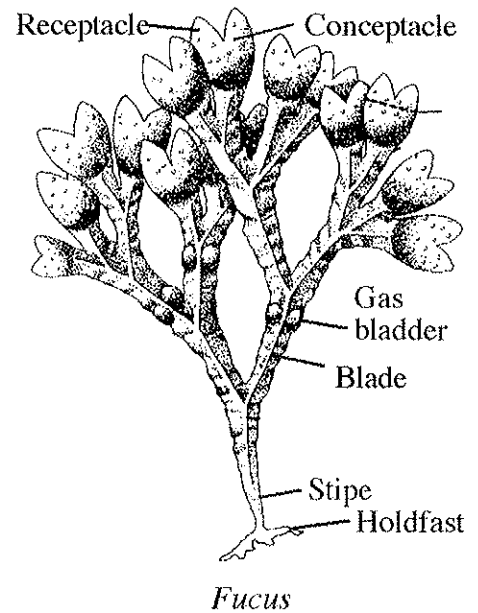
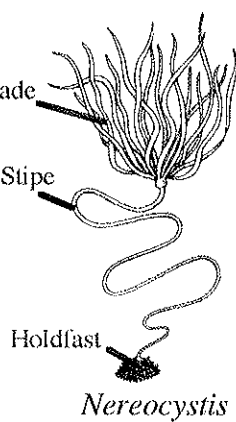
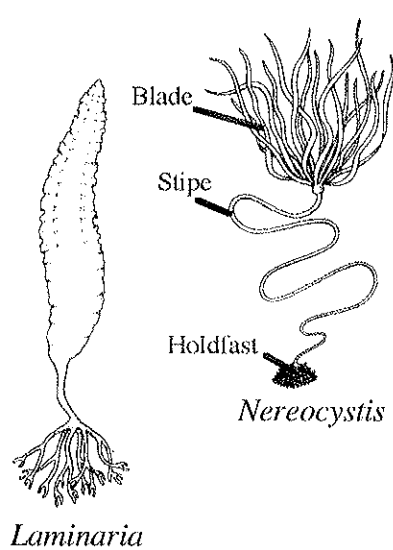


Cyclotella

Diagrams from Abramoff and Thompson (1986)

STRAMENOPILA - PHAEOPHYTA (BROWN ALGAE)

1. All are multicellular; body can often be subdivided into a blade, stipe, and holdfast.
2. Cell wall composed of cellulose, often with alginic acid and sulfated mucopolysaccharides.
3. Photosynthetic pigments are chlorophyll, carotenes, xanthophylls (including fucoxanthin).
4. Typically found in oceans; includes rockweeds, kelps (that form giant beds), and *Sargassum*.
5. Important economically as a source of algin.

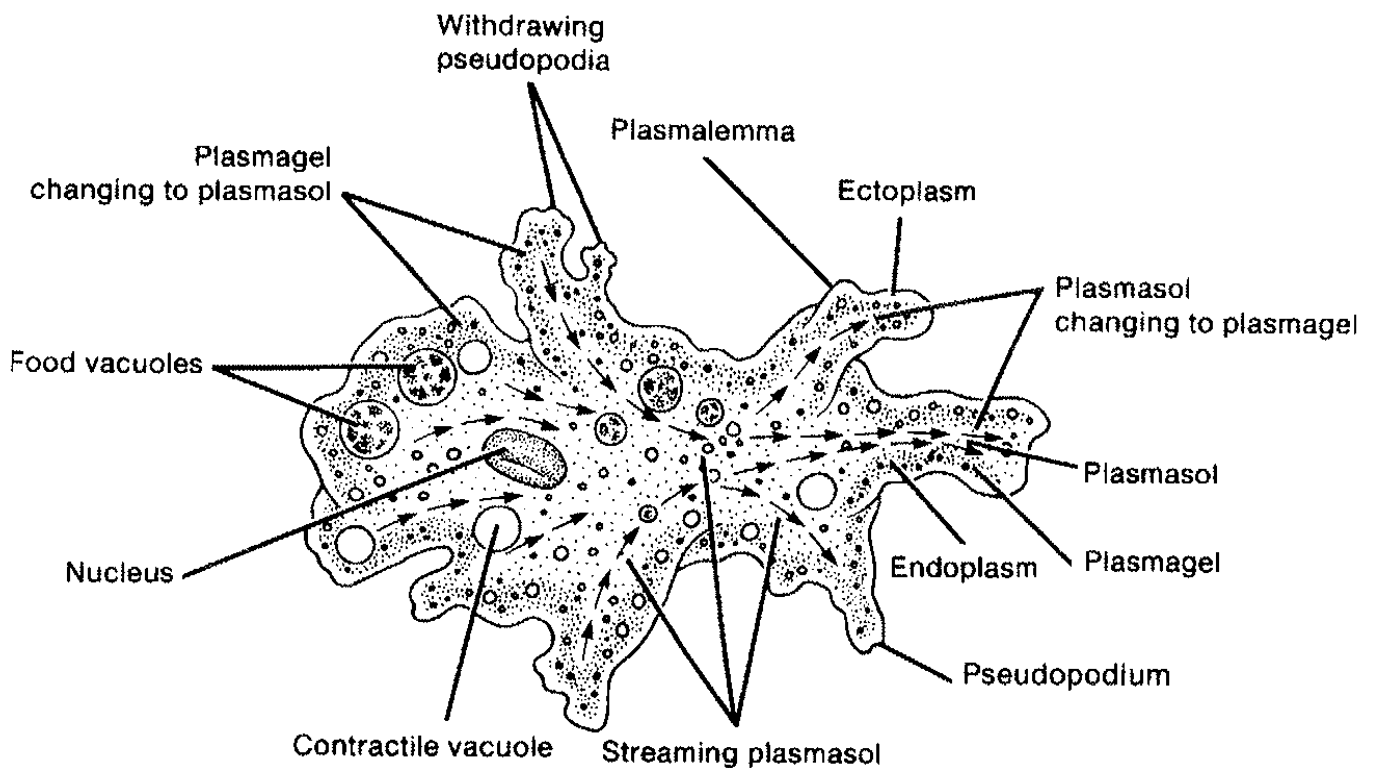


Diagrams from Abramoff and Thompson (1986)

Diagram from Pritchard and Bradt (1984)

AMOEBOZOA (AMOEBAS)

1. Bodies are "blob-shaped", capable of changing shape rapidly over time.
2. Move slowly, using blunt pseudopodia.
3. Lack a cell wall.
4. Feed phagocytotically, consuming living or dead organic matter.
6. Most are free-living, occurring in soil or open water, some are parasitic.
7. Some cause human disease (*Entamoeba*).
7. Other Amoebozoans include plasmodial and cellular slime molds.



Amoeba proteus

Diagram from Abramoff and Thompson (1986)